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UV RADIATION BY THE DEBYE SPHERE INTERACTION PLASMA - METAL NANOPARTICLES ON THE SURFACE OF PLANT TISSUE

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ABSTRACT

Using The Quantum Model Of Electrodynamics Near Field, In The Present Work It Is To Prove The Existence Of Radiation In The Uv Band, Caused By The Interaction Of Electromagnetic Field Distribution Not Neutral High Frequency Plasma With Nanoscale Metal Particles Deposited On The Surface Of A Biological Tissue Sample (Plant Samples) By Absorption Processes - Breathability.

KEYWORDS: Electromagnetic Fields, Electrical Conductivity, Hamilton Operator, Electric Permittivity & Voltage

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INTRODUCTION

If the plant tissue is taken as a sensor net of electromagnetic field and at the same time taken as natural catalyst, any change not normally generated by the environment of the sample, may be detected and quantified using signals in the same range of modification. In the event that the environment of plant tissue suspended metallic particles exist in the environment and depending on their size, these may be absorbed and subsequently re-emitted to the tissue surface as waste, but not returned to the environment, this will lead to losses tissue basic functional photosynthesizes.

In this paper the mathematical model of quantum behavior of electromagnetic fields E and B develops in the range of Debye sphere[1], for a non-neutral plasma frequency $(2 - 10).10^{16}$ Hz, doing a transformation in reciprocal space. This approach should lead to the calculation of the fine structure of the spectral lines of the emission of UV rays in the range of the area, or in other words, in the range of the Debye length for the plasma.

THEORETICAL MODEL

For the problem of the electromagnetic near field, the interaction Hamiltonian between settings high frequency plasma and a nano particle (NP), is presented as [2]:

$$\hat{H}_j = \frac{1}{2m}\left(\hat{p}_j - \frac{e}{c}\hat{A}_j\right)^2 + eEx_j - \mu B \tag{1}$$

Where: E – is electrical charge representing the electron; $\hat{p}_j$ –is operator impulse; μ - magnetic moment of NP; *B* –magnetic field generated by the plasma; $\frac{e}{c}\hat{A}_j$ - operator defines the magnetic impulse of the system.

Developing the calculation for the Hamilton operator of equation (1) in the model of Feynman path

integrals, an approximate expression is obtained for the matrix element:

$$\langle x_{j+1}|p_j A_j|x_j\rangle = e^{-\frac{i}{\hbar}\tau U^*}\frac{A_j}{\hbar}\int p_j dp_j e^{-\frac{i}{\hbar}p_j^2\frac{\tau}{2m}+\frac{i}{\hbar}\frac{e}{mc}p_j A_j \tau} \quad (2)$$

Where the function:

$$U^* = \frac{1}{2m}\left(\frac{e}{c}A_j\right)^2 + eEx_j - \mu B \quad (3)$$

In the proposed model reciprocal space, by solving the equation (2), the function that describes the radiation in the Debye sphere is:

$$f(k) = \sum_{j=1}^{n}\left(\frac{a_{j+1}j(j+1)+\alpha a_{j-1}}{\beta}\right)k_j \quad (4)$$

Where: $\alpha = \frac{2m\mu B}{\hbar^2}$; $\beta = \frac{2meE}{\hbar^2}$; k_j – representation in reciprocal space of the invert vector position.

The function described by the equation (4) becomes zero if the condition is achieved:

$$\alpha = -\frac{a_{j+1}j(j+1)}{a_{j-1}} \quad (5)$$

It is representing the magnetic moment of the system: $\mu = -\frac{\hbar^2}{2mB}\frac{a_{j+1}j(j+1)}{a_{j-1}}$

This last mathematical expression leads to the calculation of the length of radiation in the sphere of Debye as:

$$a_o = \frac{C_j}{\lambda_{UV}} \quad (6)$$

Where: C_j – conversion constant to the reciprocal space, which determines the boundary conditions.

EXPERIMENTAL PROCEDURE (Applied Technique)

For the experimental development of this work, a plasma chamber was designed with a system magnets ND incorporated, allowing focus the plasma in a region of radius of approximately 3 cm, around of the electrodes connected to the variable AC source (figure 1).

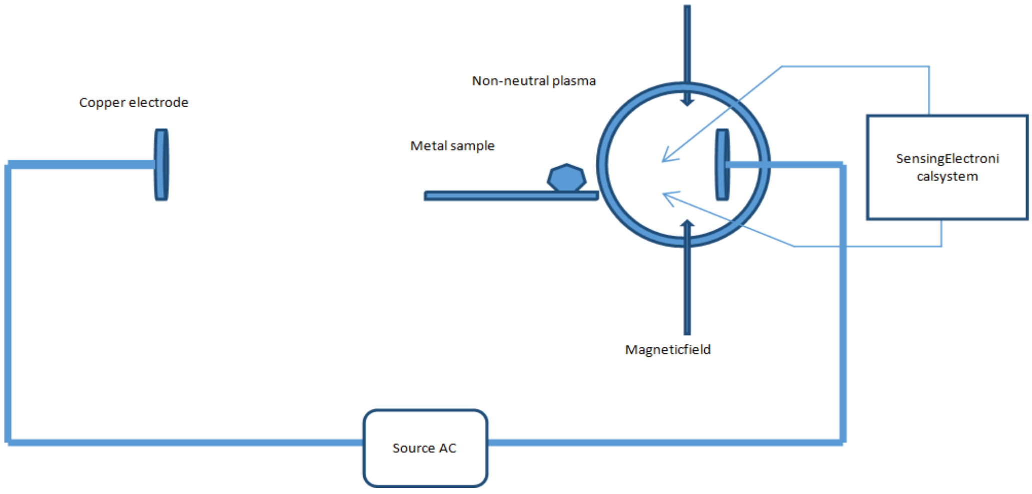

Figure 1: Schematic Representation of the Interaction of Non-Neutral Plasma with a Metal Nanoparticle on the Surface of a Sample of Plant Tissue

The electronic measuring system configured to register simultaneously, the voltage into the plasma, the frequency, the vacuum pressure, the internal temperature in the chamber and the UV radiation.

The preparation process of the plant tissue samples, was carried out with the assistance of an expert biologist on the topic of chemical detection of particles on the surface of plant tissue. Once characterized the surface of the samples, in which is certainty of the existence of nanoparticles (NPMs), we proceed to submit these to the direct action of non-neutral plasma high frequency $(2 – 10).10^{16}$ Hz generated in the chamber and afterwards, in the electronic sensing system.

Following, we register and analyze the data obtain for current, voltage and UV radiation. One of the bigger drawbacks that we had was in the register process of the frequency signal, this because the frequency was above the range of the sampling rate sensor, for these reason was necessary to make a frequency divisor, but it with the drawback of the signal that we watched in the oscilloscope was asymmetric. The previous measurement results, was gather in a database and after they were exported to simulation program with the intention to obtaining the global behavior of the interaction of plasma and the NPMs. The sample time we use was in from 0.5 to 1 minute, increased exposure time of the samples in the vacuum chamber makes them have a high dehydration in the process, which would lead to the loss on the surface of the nanoparticles

ANALYSIS OF RESULTS

In the planning and development of the mathematical model we found that for any distribution of charge carriers of hyperbolic type, the calculation of the radiation function and therefore determining the electrical conductivity leading to the establishment of a differential equation of variable coefficients known as Riccati equation, It implied that the distribution of local function in the structure has the same hyperbolic configuration.

However, if we assumed a distribution of exponential type carriers, the solution was simpler and led to a distribution of the electrical conductivity of the reverse type diffusion length L_n, L_p. [3]. It applies to nanometer distances in the simulation process, in other words, we have to see the interaction of the nanoparticles on the surface of samples as Plasmon.

The data measured current and voltage in the samples showed a behavior according to a distribution of hyperbolic type, which corresponds to the simulation process proposed in this paper. The simulation process of the equations (2) y (4) was done with the Matlab software.

- **Model Simulated of UV Radiation in Plasma**

In the figure 2, we represented the simulated model of the charge-carrier density in the Debye sphere in a radius of 300 (µm), while in the figure 3, we show the no lineal trend of the frequency distribution of these carriers is show in the same sphere. In the simulated model of the quantum function describing the frequency in the Debye sphere, we can see clearly the region of UV emission due to interaction with the surface potential of biological samples in the plasma chamber. This way of frequency distribution of carriers in the plasma produce in some areas parts of the nanoparticles adhered to the sample, an avalanche of charge carriers, that dependent of the electric potential gradient in the sample, while in others areas damming thereof produced by the electric field it is generated, sensitive to variations in structure, and which together create locally a thermal gradient.

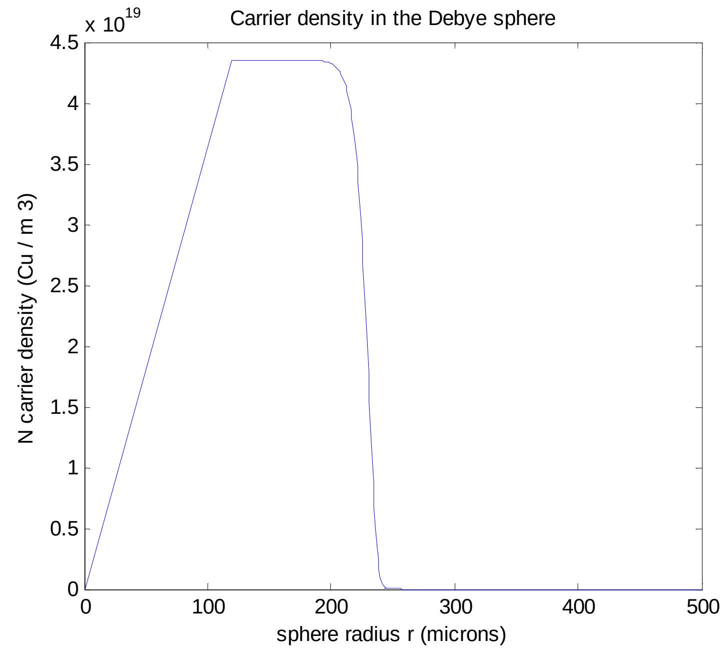

Figure 2: Simulated Model of the Thermal Behavior of Charge Carriers Ni (ions) y Ne (Electrons) in the Non-Neutral Plasma

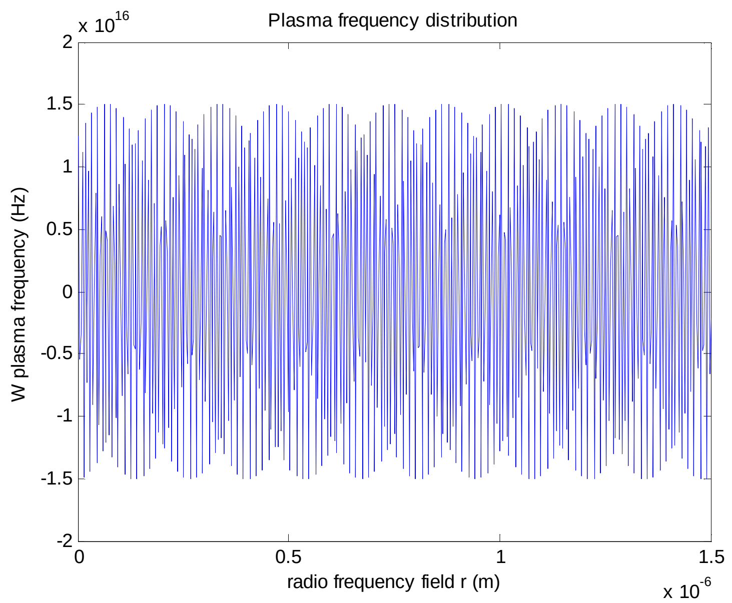

Figure 3: Simulated Model of the Behavior of the Frequency in the Plasma System Ni Charge Carriers (ions) and Ne (electrons) in the Sphere of Debye

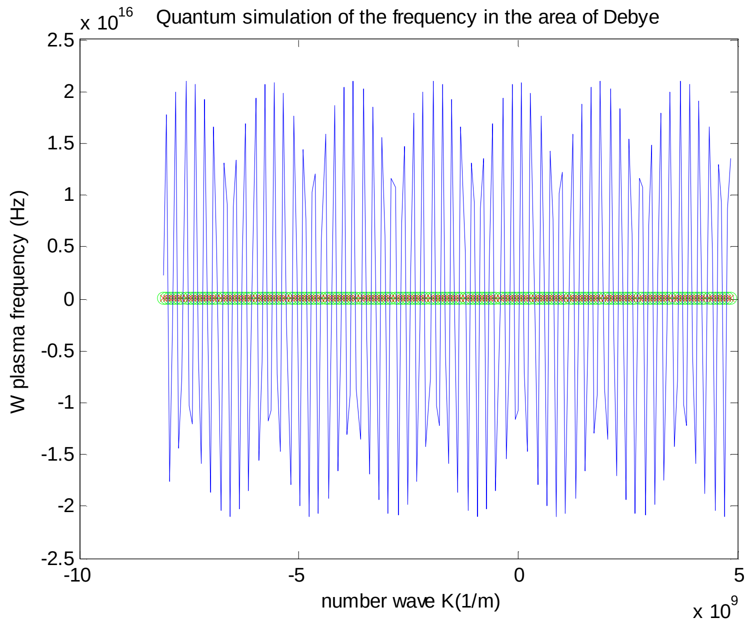

Figure 4: Simulated Model of the Frequency Behavior of UV Radiation in the Plasma System in the Quantum Configuration of Superposed States

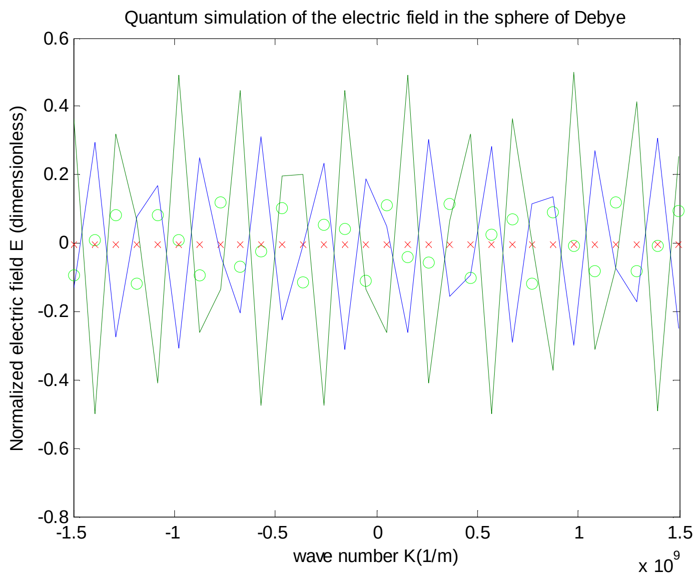

Figure 5: Simulated Model of the Behavior of the Electric Field Generated by Charge Carriers in the Plasma Systems No Depending of the Wave Number

DISCUSSIONS OF RESULTS

Given the hypothesis presented in the theory model chapter about UV radiation in the sphere Debye for a non-neutral plasma in the presence of samples of biological tissue samples in laid with metal, became apparent the anisotropic behavior of this radiation, due to multiple effects of collision between particles, tunneling effect particles on the metal surface of nanoparticles and the temperature variation. The before results are supported each with a pair of calibration functions and the experimental results obtained, which were chosen taking into account the initial conditions of the problem and that met the dynamic equations of the behavior of the internal current in the system.

CONCLUSIONS

- The anisotropic behavior of UV radiation in the Debye sphere for the non-neutral plasma results from the superposition of states radiation emitting UV atoms, therefore of the collapse of the wave functions describing the entire process. Moreover, to measure a UV signal into the plasma, gave thanks the quantum decoherence observable in the measurement.
- The above leads to improve the measurement system and to develop a series of multiple experimental tests primarily to determine with greater certainty the measurement of UV radiation into the plasma system non-neutral.
- The theoretical application of the mathematical model proposed in this paper and partial experimental results, specifically express the influence of the relative humidity of the samples and pore density in the behavior of electrical conductivity on the biological tissue, model that in other reports have not been found so far.

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